AzureWave Technologies, Inc.

AW-AM510MA

IEEE 802.11 1X1 a/b/g/n Wireless LAN + Bluetooth 5.1 Combo Module (M.2 2230)

Datasheet

Rev. A

DF

(For Standard)

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Features

WLAN

- PCIe M.2 TYPE 2230: 30mm(L) x 22mm(W) x 2.98 mm(H)(Max)
- SDIO interface support for WLAN
- Sub-meter accuracy WiFi indoor locationing(802.11mc)
- Multiple power saving modes for low power consumption
- IEEE 802.11i for advanced security
- Quality of Service (QoS) support for multimedia applications
- Support China WAPI
- Lead-free design

Bluetooth

- UART interface support for Bluetooth
- High speed PCM interfaces
- Audio Codec interface support
- Bluetooth 5.1 complaint with Bluetooth 2.1 + Enhanced Data Rate (EDR)

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Revision History

Document NO: R2-2510MA-DST-01

Version	Revision Date	DCN NO.	Description	Initials	Approved
A	2021/03/11	DCN020926	● Initial Version(new format)	Roger Liu	NC Chen

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1. Introduction

1.1 Product Overview

AzureWave Technologies, Inc. introduces the IEEE 802.11a/b/g/n WLAN, BT, combo module – **AW-AM510MA.** With four advanced radio technologies integrated into a module, AW-AM510MA provides the best and most convenient SMT process. The module is targeted to mobile devices including**,** Tablet PC, Portable Media Players (PMPs), Portable Navigation Devices (PNDs), Personal Digital Assistants (PDAs), Tracking Devices, Gaming Devices which need convenient SMT process, low power consumption.

By using **AW-AM510MA**, the customers can easily integrate the Wi-Fi, BT, by a combo module with the benefits of high design flexibility, high success rate on SMT process, short development cycle, and quick time-to-market.

Compliance with the IEEE 802.11a/b/g/n standard, the **AW-AM510MA** uses DSSS, OFDM, DBPSK, DQPSK, CCK and QAM baseband modulation technologies. A high level of integration and full implementation of the power management functions specified in the IEEE 802.11 standard minimize the system power requirements by using AW-AM510MA.

For the video, voice and multimedia applications the AW-AM510MA support 802.11e Quality of Service (QoS). The device also supports 802.11h Dynamic Frequency Selection (DFS) for detecting radar pulses when operating in the 5GHz range.

For Bluetooth operation, **AW-AM510MA** is Bluetooth 5.1 (supports Low Energy).

AW-AM510MA supports SDIO interface for WLAN and UART interface for Bluetooth to the host processor.

AW-AM510MA is suitable for multiple mobile processors for different applications with the support cellular phone co-existence.

AW-AM510MA module adopts NXP’s latest highly-integrated dual-band WLAN & Bluetooth SoC---**IW416**. All the other components are implemented by all means to reach the mechanical specification required.

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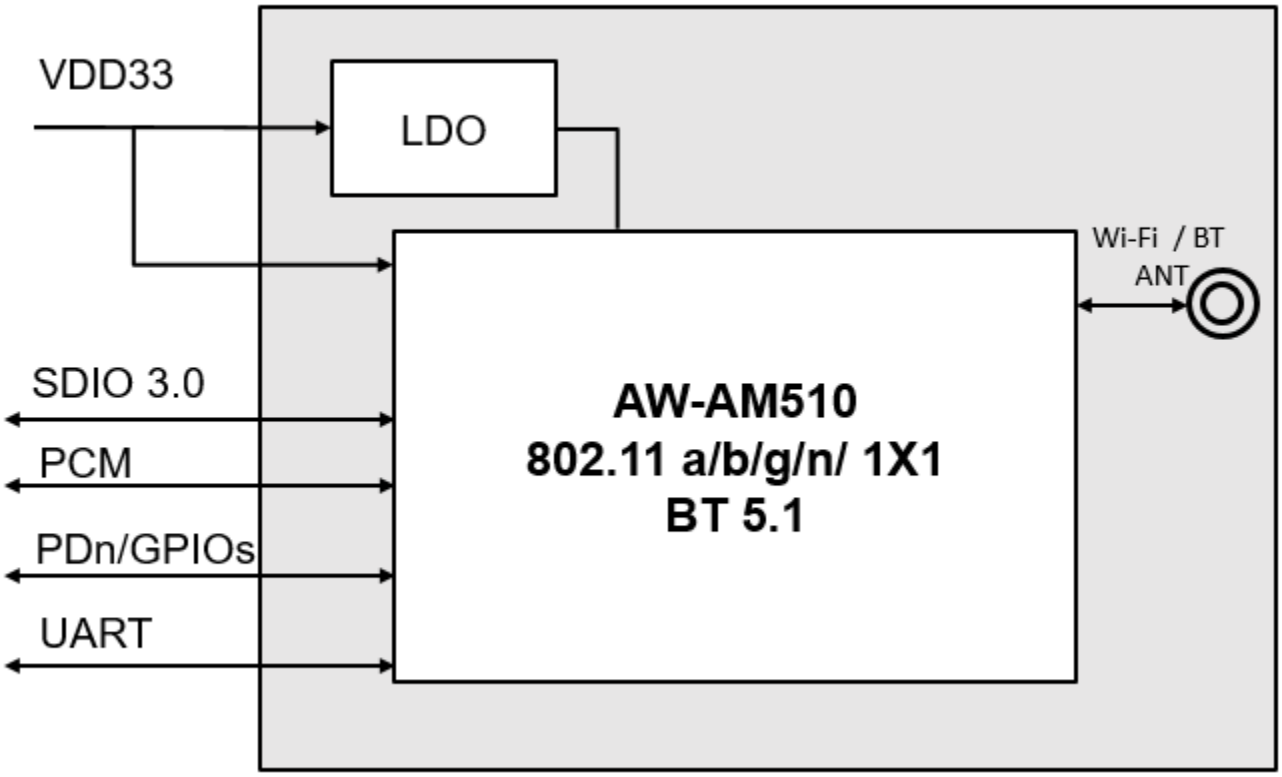
1.2 Block Diagram



AW-AM510MA Block Diagram

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1.3 Specifications Table

1.3.1 General

Features	Description
Product Description	IEEE 802.11a/b/g/n Wireless LAN 1T1R and Bluetooth 5.1 Combo Module (M.2 2230)
Major Chipset	NXP IW416
Host Interface	WiFi + BT ● SDIO + UART
Dimension	22mm(W) x 30mm(L) x 2.7mm(H) (Tolerance remarked in mechanical drawing)
Form factor	M.2 2230
Antenna	I-PEX MHF4 Connector Receptacle (20449) ANT：WiFi / Bluetooth→ TX/RX
Weight	TBD g

1.3.2 WLAN

Features	Description
WLAN Standard	IEEE 802.11 a/b/g/n 1T1R
WLAN VID/PID	NA
WLAN SVID/SPID	NA
Frequency Rage	2.4 GHz：2.412 ~ 2.484 GHz 5 GHz：4.915 ~5.925GHz
Modulation	DSSS, OFDM, DBPSK, DQPSK, CCK, 16-QAM, 64-QAM
Number of Channels	**2.4GHz** ■ USA, NORTH AMERICA, Canada and Taiwan – 1 ~ 11 ■ China, Australia, Most European Countries, Japan – 1 ~ 13 **5GHz** ■ USA, ■ EUROPE –36,40,44,48,52,56,60,64,100,104,108,112,116,120, 124,128,132,136,140,149,153,157,161,165

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Output Power (Board Level Limit)*

2.4G

	Min	Typ	Max	Unit
11b (11Mbps) @EVM<35%		TBD		dBm
11g (54Mbps) @EVM≦-27 dB		TBD		dBm
11n (HT20 MCS7) @EVM≦-28 dB		TBD		dBm
11n (HT40 MCS7) @EVM≦-28 dB		TBD		dBm

5GHz

	Min	Typ	Max	Unit
11a (54Mbps) @EVM≦-27 dB		TBD		dBm
11n (HT20 MCS7) @EVM≦-28 dB		TBD		dBm
11n (HT40 MCS7) @EVM≦-28 dB		TBD		dBm

Receiver Sensitivity

2.4GHz

	Min	Typ	Max	Unit
11b (11Mbps)	-	TBD		dBm
11g (54Mbps)	-	TBD		dBm
11n (HT20 MCS7)	-	TBD		dBm
11n (HT40 MCS7)	-	TBD		dBm

5GHz

	Min	Typ	Max	Unit
11a (54Mbps)	-	TBD		dBm
11n (HT20 MCS7)	-	TBD		dBm
11n (HT40 MCS7)	-	TBD		dBm

Data Rate

- 802.11b: 1, 2, 5.5, 11Mbps
- 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
- 802.11n: up to 150Mbps-single

Security

- WAPI
- WEP 64-bit and 128-bit encryption with H/W TKIP processing
- WPA/WPA2 (Wi-Fi Protected Access)
- AES-CCMP hardware implementation as part of 802.11i security standard

* If you have any certification questions about output power please contact FAE directly.

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1.3.3 Bluetooth

<table>
<tr><th>Features</th><th>Description</th></tr>
<tr><td>Bluetooth Standard</td><td>Bluetooth 2.1 and 3.0+Enhanced Data Rate (EDR) + BT 5.1</td></tr>
<tr><td>Bluetooth VID/PID</td><td>NA</td></tr>
<tr><td>Frequency Rage</td><td>2402~2480MHz</td></tr>
<tr><td>Modulation</td><td>GFSK (1Mbps), Π/4 DQPSK (2Mbps) and 8DPSK (3Mbps)</td></tr>
<tr><td>Output Power</td><td>
<table>
<tr><td></td><td>Min</td><td>Typ</td><td>Max</td><td>Unit</td></tr>
<tr><td>BDR</td><td></td><td>TBD</td><td></td><td>dBm</td></tr>
<tr><td>EDR</td><td></td><td>TBD</td><td></td><td>dBm</td></tr>
<tr><td>BLE</td><td></td><td>TBD</td><td></td><td>dBm</td></tr>
</table>
</td></tr>
<tr><td>Receiver Sensitivity</td><td>
<table>
<tr><td></td><td>Min</td><td>Typ</td><td>Max</td><td>Unit</td></tr>
<tr><td>BDR</td><td></td><td>TBD</td><td></td><td>dBm</td></tr>
</table>
BER < 0.1%
</td></tr>
</table>

1.3.4 Operating Conditions

Features	Description
Operating Conditions	
Voltage	Power supply for host:3.3V
Operating Temperature	0℃ to 70 ℃
Operating Humidity	less than 85% R.H.
Storage Temperature	-40℃ to 125 ℃
Storage Humidity	less than 60% R.H.
ESD Protection	
Human Body Model	TBD
Changed Device Model	TBD

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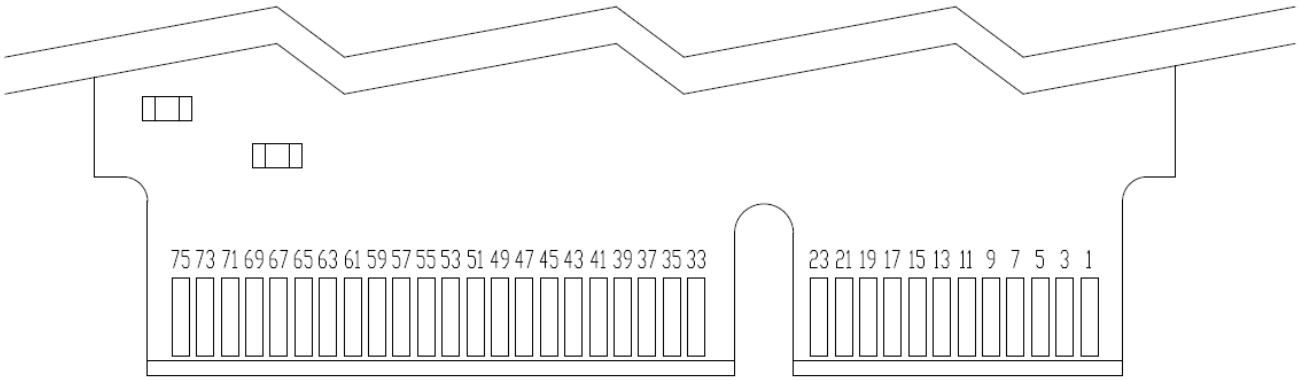
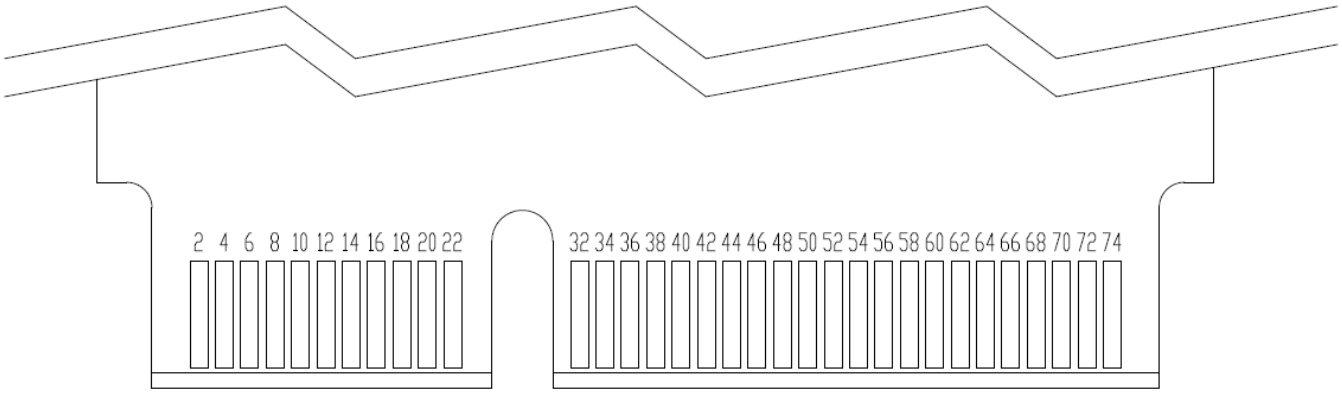
2. Pin Definition

2.1 Pin Map



PIN DEFINED (TOP VIEW)



PIN DEFINED (BOTTOM VIEW)

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2.2 Pin Table

Pin No	Definition	Basic Description	Voltage	Type
1	GND	Ground		GND
2	3.3V	3.3V power supply.	3.3V	Power
3	NC	No connect to anything		Floating
4	3.3V	3.3V power supply	3.3V	Power
5	NC	No connect to anything		Floating
6	NC	No connect to anything		Floating
7	GND	Ground		GND
8	PCM_CLK	PCM clock	1.8V	I/O
9	SDIO CLK	SDIO CLK	1.8V	I
10	PCM_SYNC	PCM Synchronization control	1.8V	O
11	SDIO CMD	SDIO CMD	1.8V	I/O
12	PCM_OUT	PCM data Out	1.8V	O
13	SDIO DAT[0]	SDIO Data [0]	1.8V	I/O
14	PCM_IN	PCM data Input	1.8V	I
15	SDIO DAT[1]	SDIO Data [1]	1.8V	I/O
16	NC	No connect to anything		Floating
17	SDIO DAT[2]	SDIO Data [2]	1.8V	I/O
18	GND	Ground.		GND
19	SDIO DAT[3]	SDIO Data [3]	1.8V	I/O
20	UART_WAKE#	BT Host Wake	3.3V	O
21	SDIO_WAKE#	Wlan Host Wake	1.8V	I/O
22	UART_TXD	UART_SOUT	1.8V	O
23	SDIO_RESET#	Host-to-WLAN wake ※This pin used the same module GPIO with JTAG_TCK	1.8V	I
32	UART_RXD	UART_SIN	1.8V	I
33	GND	Ground.		GND
34	UART_RTS	UART_RTSn (active low)	1.8V	O
35	NC	No connect to anything		Floating
36	UART_CTS	UART_CTSn(active low)	1.8V	I
37	NC	No connect to anything		Floating
38	JTAG_TDO	JTAG_TDO	1.8V	I/O
39	GND	Ground		GND
40	WL_DEV_WAKE	Host-to-Wi-Fi reset	1.8V	I/O
41	NC	No connect to anything		Floating
42	BT_DEV_WAKE	BT Device Wake	1.8V	I/O
43	NC	No connect to anything		Floating
44	JTAG_TDI	JTAG_TDI	1.8V	I/O
45	GND	Ground		GND
46	JTAG_TCK	JTAG_TCK ※This pin used the same module GPIO with SDIO_RESET#	1.8V	I/O
47	NC	No connect to anything		Floating
48	JTAG_TMS	JTAG_TMS ※This pin used the same module GPIO with W_DISABLE#2	1.8V	I

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49	NC	No connect to anything		Floating
50	SUSCLK_32KHz	External sleep clock input (32.768 kHz).	3.3V	I
51	GND	Ground		GND
52	NC	No connect to anything		Floating
53	NC	No connect to anything		Floating
54	W_DISABLE#2	Host-to-Bluetooth reset ※This pin used the same module GPIO with JTAG_TMS	3.3V	I
55	NC	No connect to anything		Floating
56	W_DISABLE#1	PDn Full Power-Down (input) (active low) The module internal pull-up 51kΩ on this pin.	1.8V	I
57	GND	Ground		GND
58	NC	No connect to anything		Floating
59	NC	No connect to anything		Floating
60	NC	No connect to anything		Floating
61	NC	No connect to anything		Floating
62	NC	No connect to anything		Floating
63	GND	Ground		GND
64	NC	No connect to anything		Floating
65	NC	No connect to anything		Floating
66	NC	No connect to anything		Floating
67	NC	No connect to anything		Floating
68	NC	No connect to anything		Floating
69	GND	Ground		GND
70	NC	No connect to anything		Floating
71	NC	No connect to anything		Floating
72	3.3V	3.3V power supply	3.3V	Power
73	NC	No connect to anything		Floating
74	3.3V	3.3V power supply	3.3V	Power
75	GND	Ground		GND
76	GND	Ground		GND

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3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Minimum	Typical	Maximum	Unit
3.3V	DC supply for the 3.3V input	-	3.3	3.96	V

3.2 Recommended Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Unit
1.8V	1.8V digital I/O power supply	--	1.62	1.8	1.98
3.3V	3.3V VBAT input	--	2.97	3.3	3.63
TA	Ambient operating temperature	--	-30		85

3.3 Digital IO Pin DC Characteristics

3.3.1 DC Electricals-1.8V Operation(VIO)

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VIL	Input low voltage	-0.4	-	0.3*V18	V
VIH	Input high voltage	0.7*V18	-	V18+0.4	V
V_{HYS}	Input hysteresis	100	-	-	mV
VOL	Output low voltage	-	-	0.4	V
VOH	Output high voltage	V18-0.4	-	-	V
VOH	Output high voltage	V33-0.4	-	-	V

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3.4 Host Interface

3.4.1 SDIO Interface

The AW-AM510MA supports a SDIO device interface that conforms to the industry standard SDIO Full-Speed card specification and allows a host controller using the SDIO bus protocol to access the Wireless module device.

The AW-AM510MA acts as the device on the SDIO bus. The host unit can access registers of the SDIO interface directly and can access shared memory in the device through the use of BARs and a DMA engine.

The SDIO device interface main features include:

Supports SDIO 3.0 Standard

On-chip memory used for CIS

Supports SPI, 1-bit SDIO, and 4-bit SDIO transfer modes

Special interrupt register for information exchange

Allows card to interrupt host

3.4.1.1. SDIO Interface Signal Description

Pin Name	Signal Name	Type	Description
SD_CLK	CLK	I/O	SDIO 1-bit mode: Clock SDIO SPI mode: Clock
SD_CMD	CMD	I/O	SDIO 1-bit mode: Command line SDIO SPI mode: Data input
SD_DAT[3]	DAT3	I/O	SDIO 4-bit mode: Data line bit [3] SDIO 1-bit mode: Not used SDIO SPI mode: Chip select (active low)
SD_DAT[2]	DAT2	I/O	SDIO 4-bit mode: Data line bit [2] or Read Wait (optional) SDIO 1-bit mode: Read Wait (optional) SDIO SPII mode: Reserved
SD_DAT[1]	DAT1	I/O	SDIO 4-bit mode: Data line bit [1] SDIO 1-bit mode: Interrupt SDIO SPI mode: Interrupt
SD_DAT[0]	DAT0	I/O	SDIO 4-bit mode: Data line bit [0] SDIO 1-bit mode: Data line SDIO SPI mode: Data output

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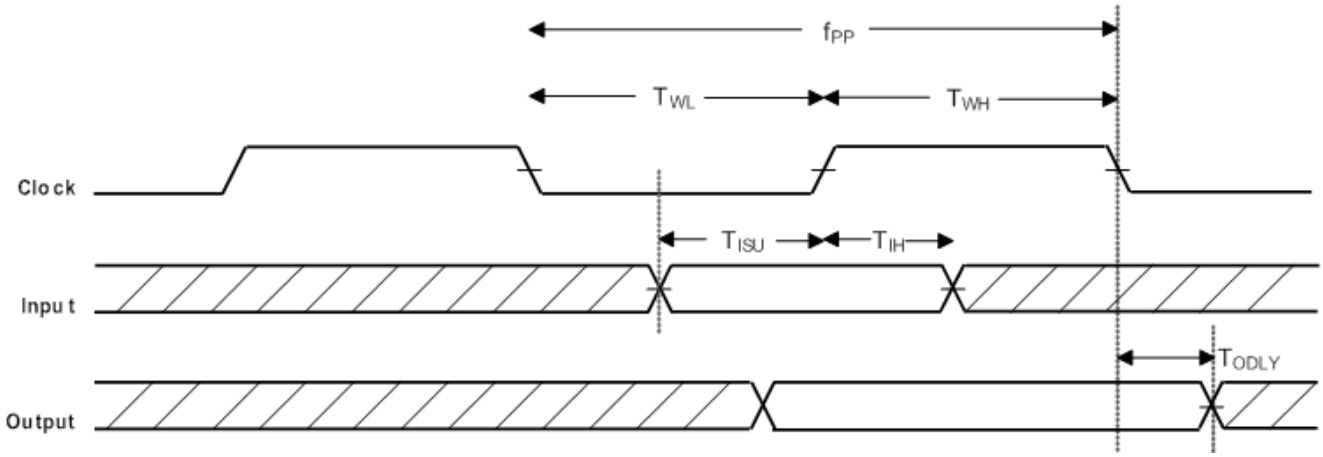
3.4.1.2. Default Speed, High Speed Modes

SDIO Protocol Timing Diagram – Default Speed Mode



SDIO Protocol Timing Diagram – HighSpeed Mode

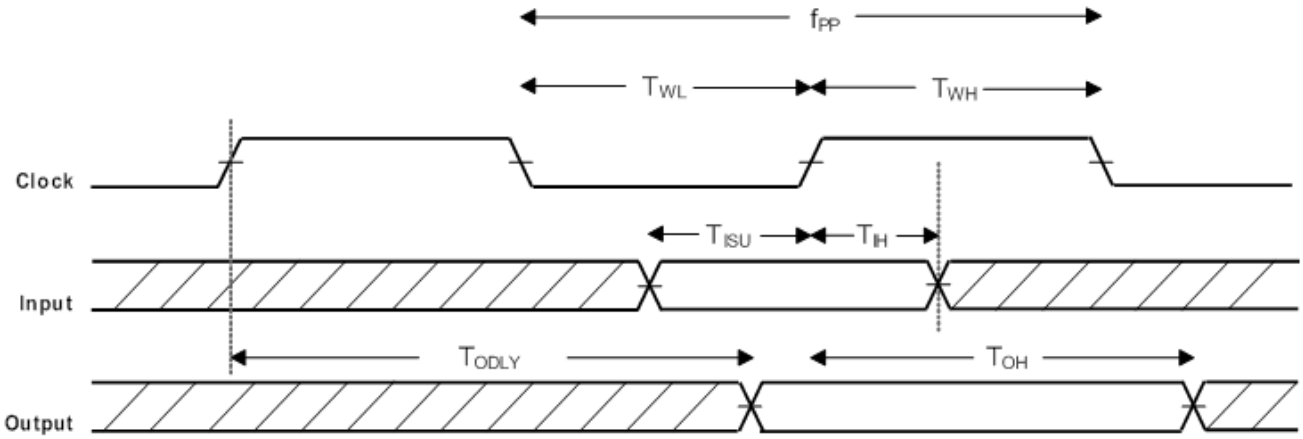


Table shows SDIO Timing Data—Default Speed, High Speed Modes

NOTE: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

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Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{PP}	Clock Frequency	Default Speed	0	--	25	MHz
		High Speed	0	--	50	MHz
T_{WL}	Clock Low Time	Default Speed	10	--	--	ns
		High Speed	7	--	--	ns
T_{WH}	Clock High Time	Default Speed	10	--	--	ns
		High Speed	7	--	--	ns
T_{ISU}	Input Setup Time	Default Speed	5	--	--	ns
		High Speed	6	--	--	ns
T_{IH}	Input Hold Time	Default Speed	5	--	--	ns
		High Speed	2	--	--	ns
T_{ODLY}	Output Delay Time CL ≤ 40 pF (1 card)	Default Speed	--	--	14	ns
		High Speed	---	-1	4	ns
T_{OH}	Output Hold Time	High Speed	2.5	--	--	ns

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3.4.1.3. SDR12, SDR25, SDR50 Modes (up to 100MHz)

SDIO Protocol Timing Diagram – SDR12,SDR25,SDR50 Modes (up to 100MHz)

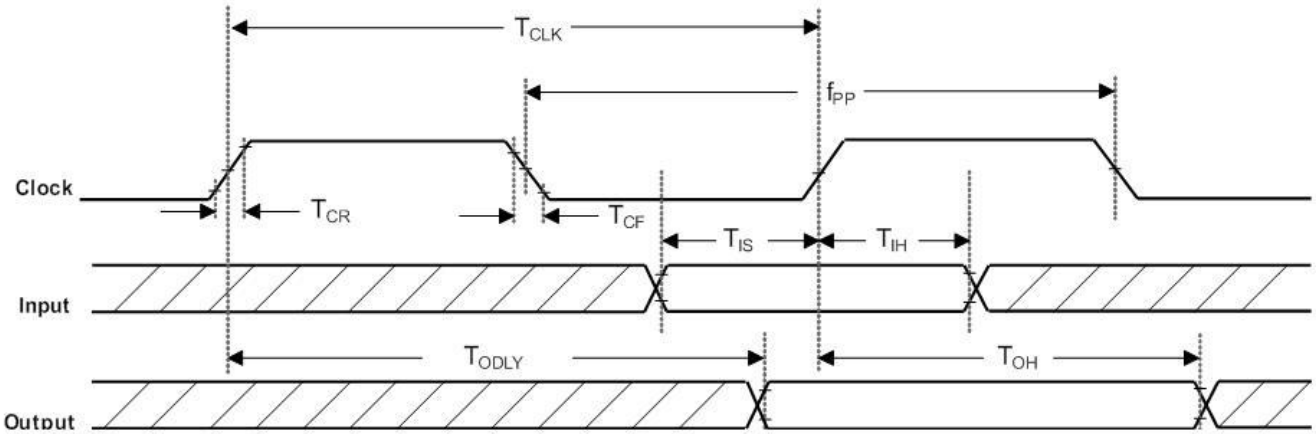

Table shows SDIO Timing Data—SDR12,SDR25,SDR50 Modes (up to 100MHz)

Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{PP}	Clock frequency	SDR12/25/50	25	--	100	MHz
T_{IS}	Input setup time	SDR12/25/50	3	--	--	ns
T_{IH}	Input hold time	SDR12/25/50	0.8	--	--	ns
T_{CLK}	Clock time	SDR12/25/50	10	--	40	ns
T_{CR}, T_{CF}	Rise time, fall time T_{CR}, T_{CF} < 2 ns (max) at 100 MHz C_{CARD} = 10 pF	SDR12/25/50	--	--	0.2*T_{CLK}	ns
T_{ODLY}	Output delay time C_L ≤ 30 pF	SDR12/25/50	--	--	7.5	ns
T_{OH}	Output hold time C_L = 15 pF	SDR12/25/50	1.5	--	--	ns

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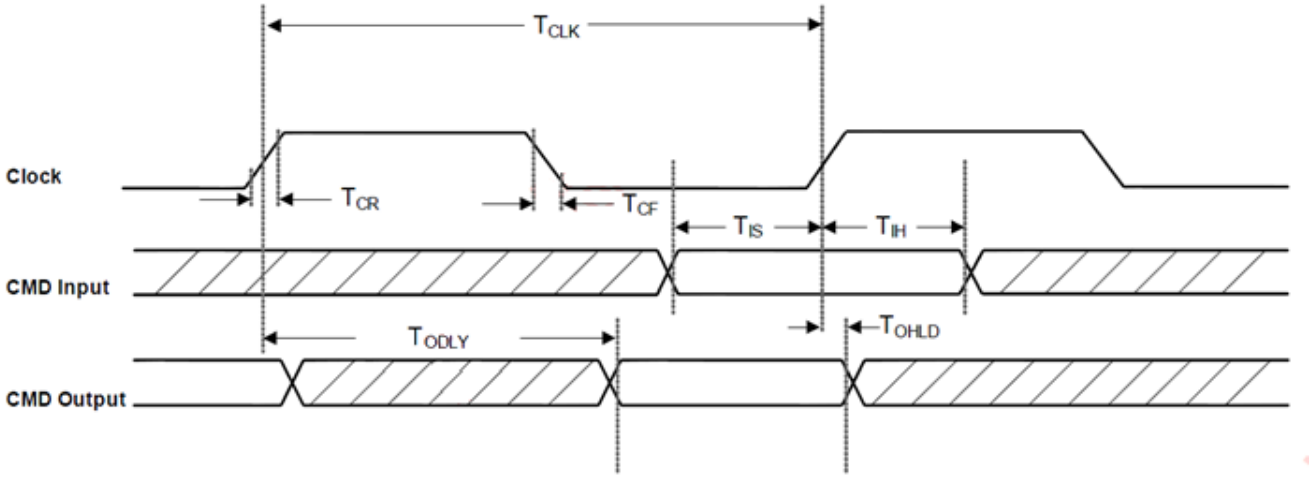
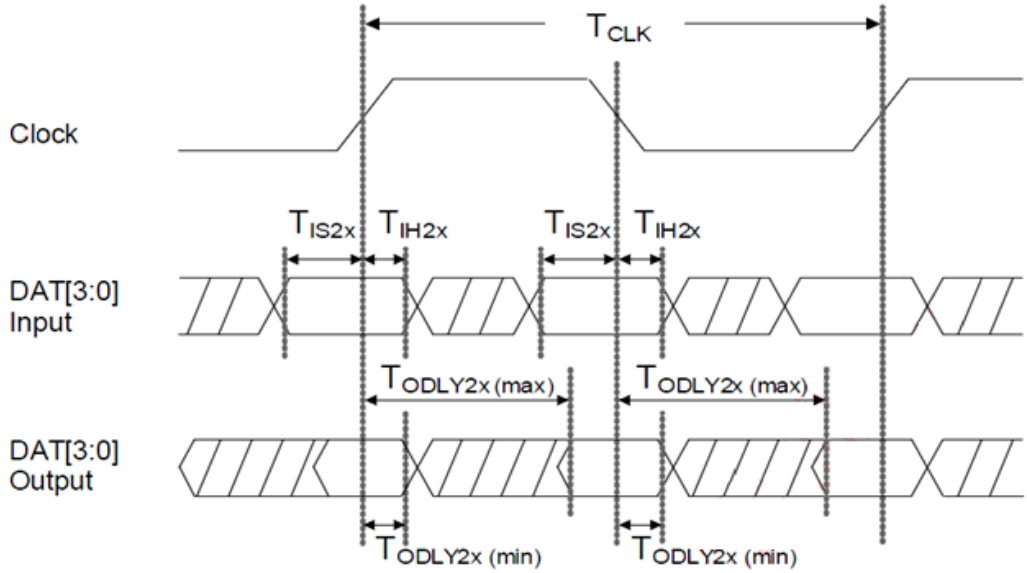
3.4.1.4 DDR50 Mode (50MHz) (1.8V)



SDIO CMD Timing Diagram - DDR50 Mode (50 MHz)



SDIO DAT[3:0] Timing Diagram - DDR50 Mode[1] (50 MHz)

[1] In DDR50 mode, DAT[3:0] lines are sampled on both edges of the clock (not applicable for CMD line).

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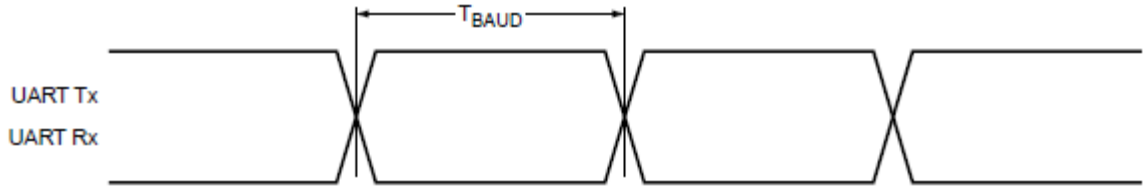
Symbol	Parameter	Condition	Min	Typ	Max	Units
Clock						
T_{CLK}	Clock time	DDR50	20	-	-	ns
T_{CR}, T_{CF}	Rise time, fall time	DDR50	-	-	0.2*T_{CLK}	Ns
Clock Duty		DDR50	45	-	55	%
CMD Input						
T_{IS}	Input setup time	DDR50	6	-	-	ns
T_{IH}	Input hold time	DDR50	0.8	-	-	ns
CMD Output						
T_{ODLY}	Output delay time during data transfer mode	DDR50	-	-	13.7	ns
T_{OHLD}	Output hold time	DDR50	1.5	-	-	ns
DAT [3:0] Input						
T_{IS2X}	Input setup time	DDR50	3	-	-	ns
T_{IH2X}	Input hold time	DDR50	0.8	-	-	ns
DAT [3:0] Output						
$T_{ODLY2X(max)}$	Output delay time during data transfer mode	DDR50	-	-	7	ns
$T_{ODLY2X(min)}$	Output hold time	DDR50	1.5	-	-	ns

SDIO Timing Data - DDR50 Mode (50MHz)

3.4.2.High-Speed UART Interface

The AW-AM510MA supports a high-speed Universal Asynchronous Receiver/Transmitter (UART) interface, compliant to the industry standard 16550 specification. High-speed baud rates are supported to provide the physical transport between the device and the host for exchanging Bluetooth data.



Symbol	Parameter	Condition	Min	Typ	Max	Units
T_{BAUD}	Baud rate	26MHz input clock	250	-	-	ns

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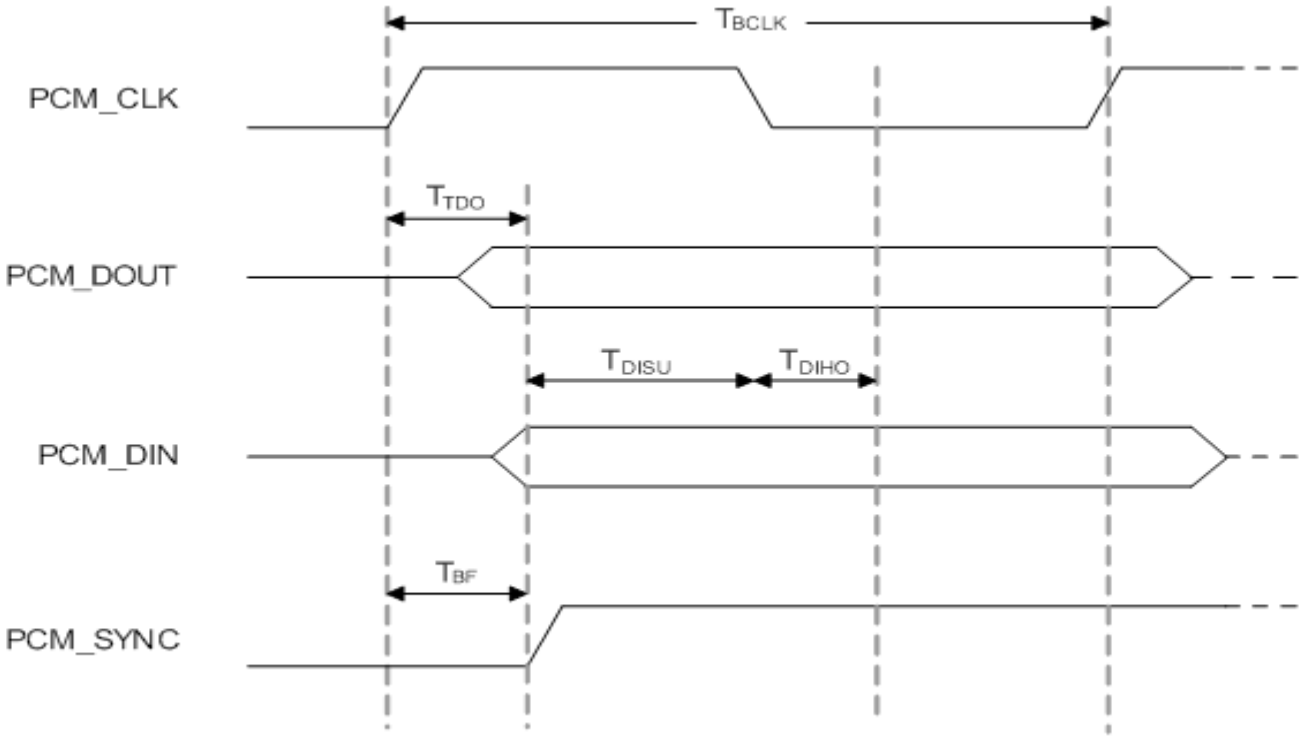
3.4.3. PCM Interface

3.4.3.1 PCM Timing Specification – Master Mode



Symbol	Parameter	Condition	Min	Typ	Max	Units
F_{BCLK}	--	--	--	2/2.048	--	MHz
Duty $Cycle_{BCLK}$	--	--	0.4	0.5	0.6	--
$T_{BCLK\ rise/fall}$	--	--	--	3	--	ns
T_{DO}	--	--	--	--	15	ns
T_{DISU}	--	--	20	--	--	ns
T_{DIHO}	--	--	15	--	--	ns
T_{BF}	--	--	--	--	15	ns

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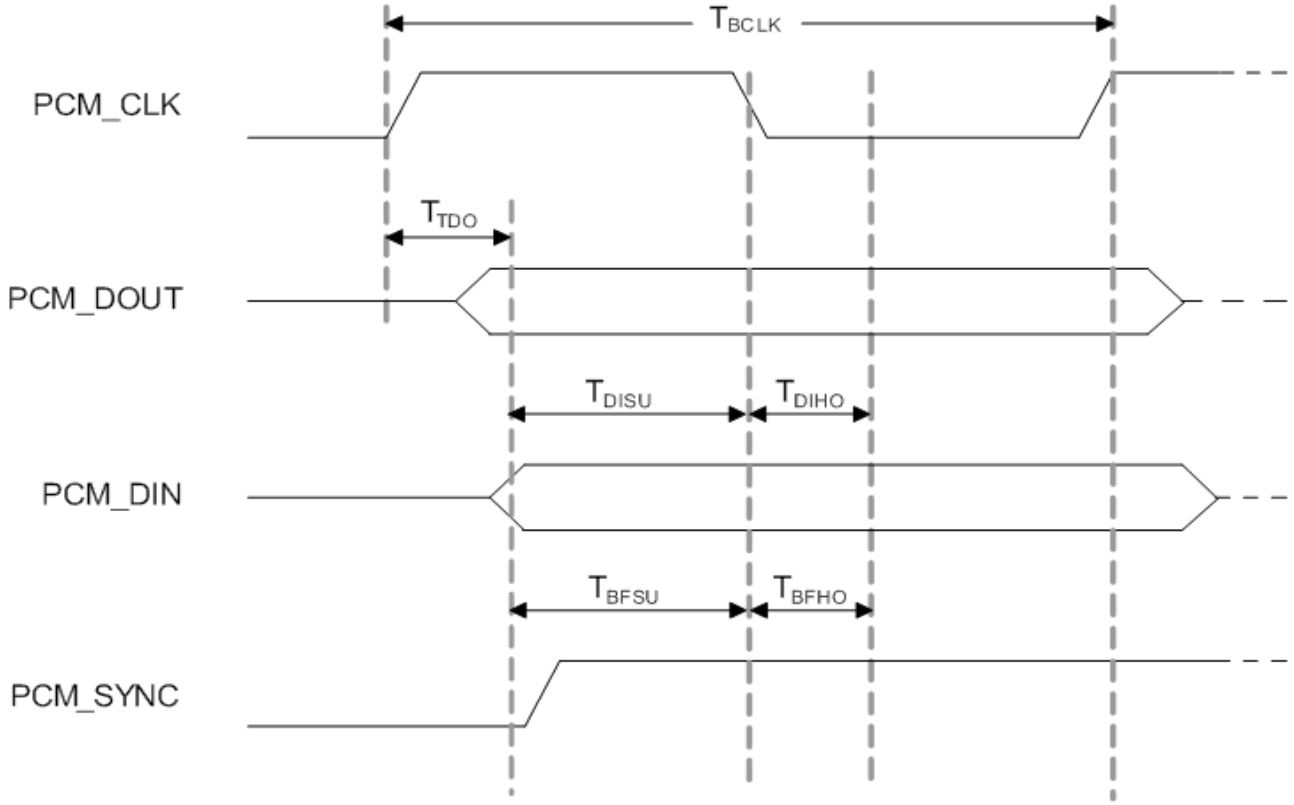
3.4.3.2 PCM Timing Specification – Slave Mode



Symbol	Parameter	Condition	Min	Typ	Max	Units
F_{BCLK}	--	--	--	2/2.048	--	MHz
Duty $Cycle_{BCLK}$	--	--	0.4	0.5	0.6	--
$T_{BCLK\ rise/fall}$	--	--	--	3	--	ns
T_{DO}	--	--	--	--	30	ns
T_{DISU}	--	--	15	--	--	ns
T_{DIHO}	--	--	10	--	--	ns
T_{BFSU}	--	--	15	--	--	ns
T_{BFHO}	--	--	10	--	--	ns

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3.5 Power up Timing Sequence

TBD

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3.6 Power consumption

3.6.1 WLAN result

	Item			VBAT=3.3V				
Band (GHz)	Mode	BW (MHz)	RF Power (dBm)	Transmit			Receive	
				Max.	Avg.	DUTY %	Max.	Avg.
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

* The power consumption is based on Azurewave test environment, these data for reference only.

3.6.2 Bluetooth

No.	Mode	VBAT=3.3V			
		Transmit		Receive	
		Max.	Avg.	Max.	Avg.
TBD	TBD	TBD	TBD	TBD	TBD

* The power consumption is based on Azurewave test environment, these data for reference only.

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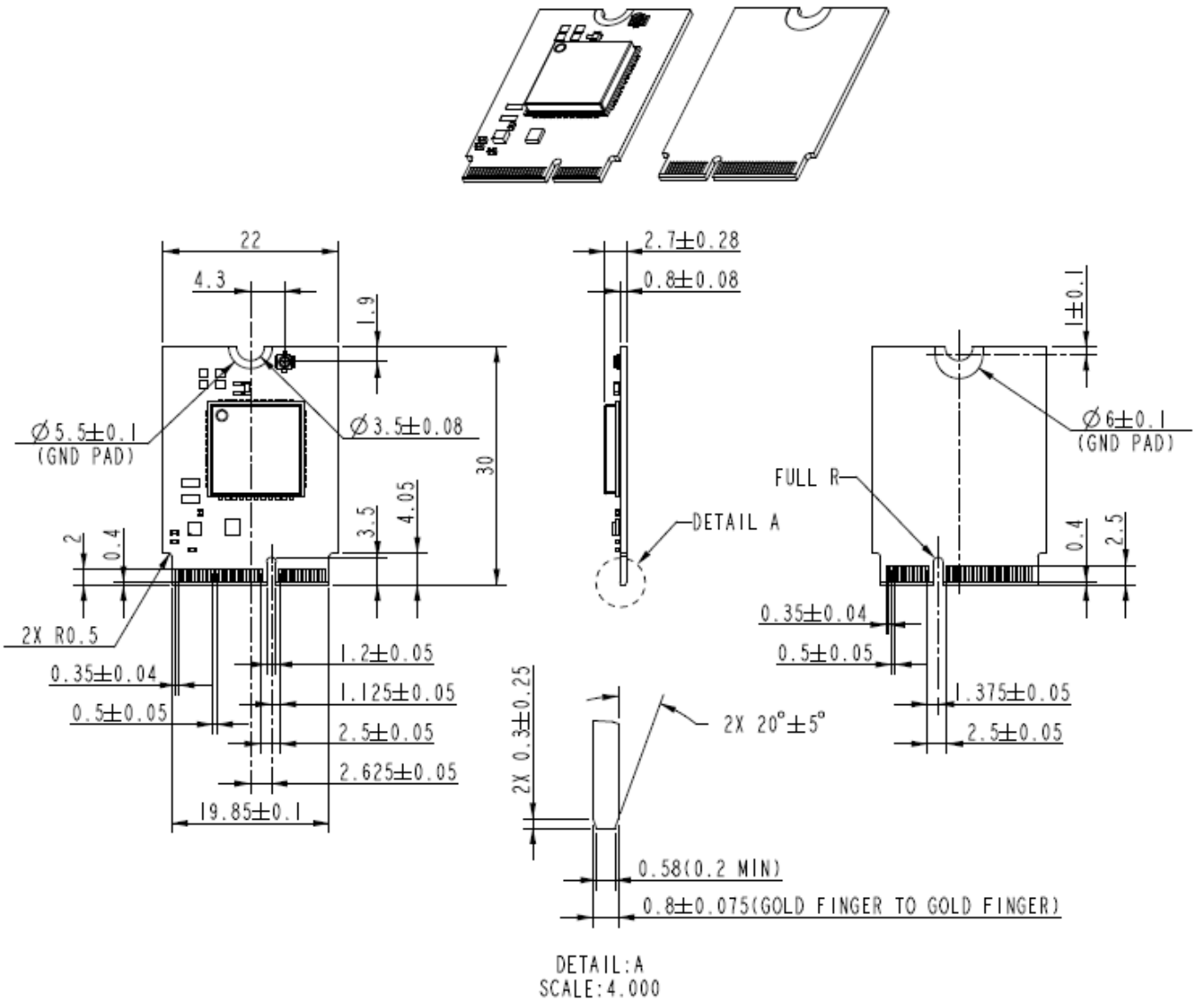
4. Mechanical Information

4.1 Mechanical Drawing



TOLERANCE UNLESS OTHERWISE SPECIFIED:±0.15mm

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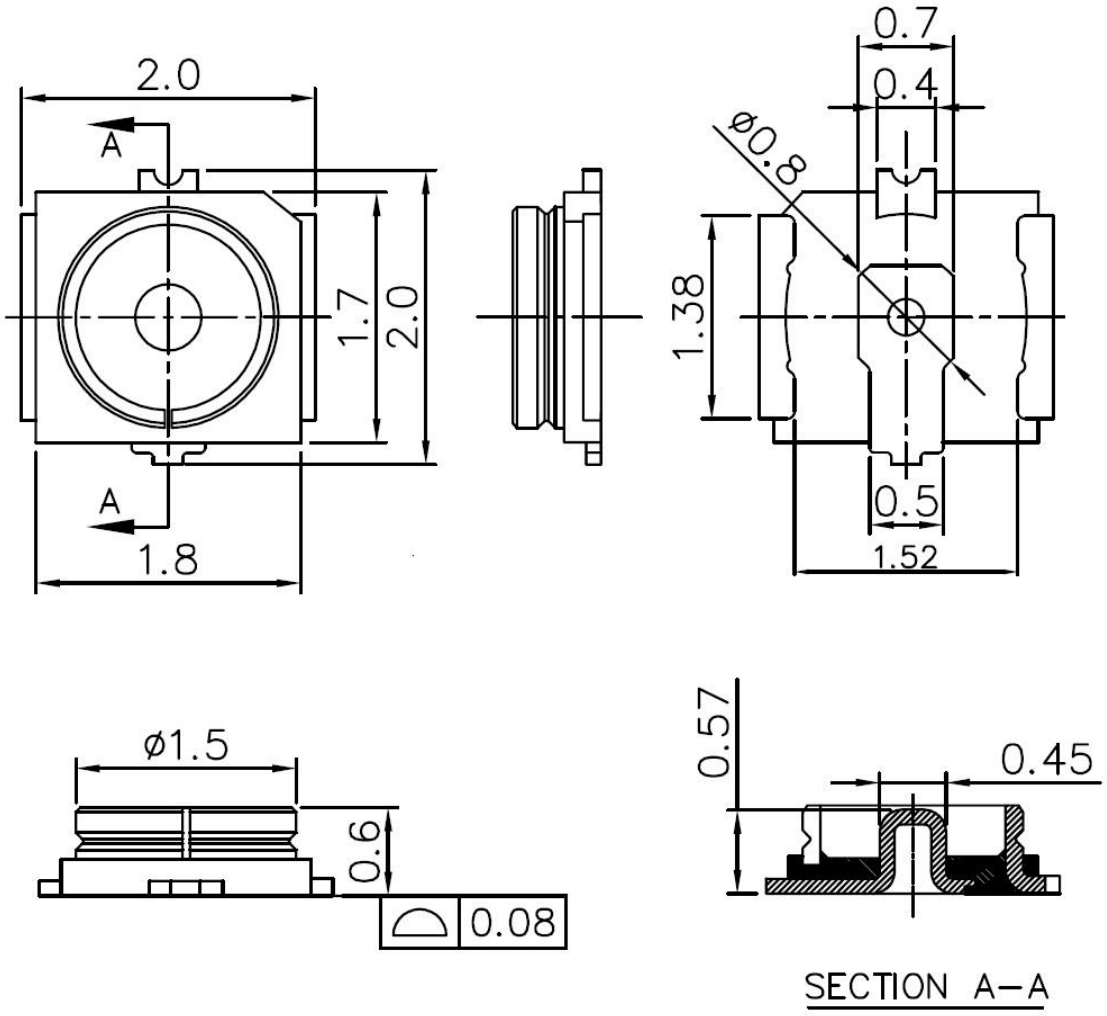
4.2 Antenna connector drawing



UNITS: mm

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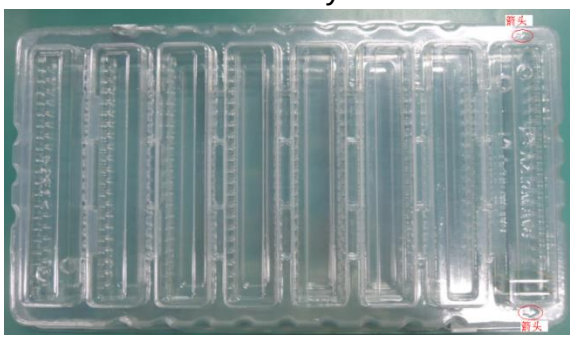
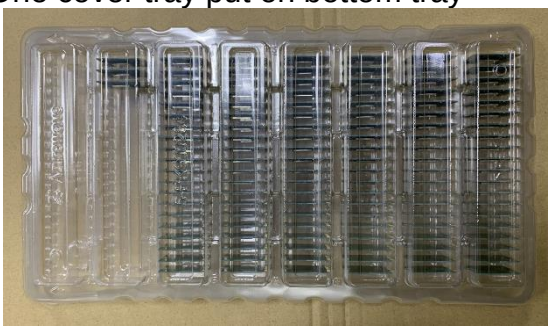
5. Packaging Information

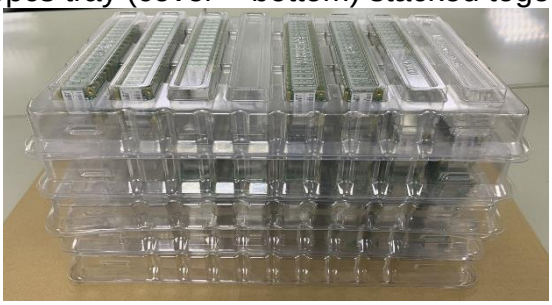
1. 160pcs M.2 2230 modules put in the one bottom tray



2. One cover tray put on bottom tray



3. 5pcs tray (cover + bottom) stacked together



4. Use P.P Strap to pack 5 trays

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5. Put packed trays into inner box

6. Seal the inner box by AzureWave tape

7. One package label pasted in side of inner box

Example:

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8. Two inner boxes put into one carton; If only one inner box has modules, “Empty” label pasted on the other one inner box

Example:

9. Seal the carton by AzureWave tape

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10. One carton label and box label pasted on the carton. If the carton is not full, one balance label pasted on the carton

Example of carton label	AzureWave P/N: Customer: 由業務提供 Customer P/N: 由業務提供 Customer PO: 由業務提供 Description: AW-XXXXXX QTY: 1200 pcs C/N: N.W.: G.W. RoHS COMPLIANT
Example of box label	
Example of production label	
Example of balance label	

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